

ABSTRACT

The present invention involves three dimensional woven structures which include interwoven bias fibers and at least one integrally woven junction, and a loom for weaving these structures. The loom includes bias fiber holders, bias shuttles, and independently controllable bias arms to interweave the bias fibers.

5 Each bias fiber holder holds a bias fiber under tension. The bias shuttles may releasably grip a number of the bias fiber holders and translate them horizontally between a plurality of predetermined horizontal positions. Each bias shuttle is at a separate vertical position. At least one bias shuttle translates above the shed and at

10 least one bias shuttle translates below the shed. Each independently controllable bias arm may releasably grip one of the bias fiber holders and translate it vertically, at one of the predetermined horizontal positions, with a range of motion extending at least between two of the bias shuttles.